

discernment of a possible method of controlling sex.

It is interesting to note that pursuit of this speculation leads one to a view of the paramount importance of the individual as a whole in determining its characters, and in this respect recalls Darwin's hypothesis of pangenesis. It may be pointed out, moreover, that quite apart from theoretical questions the conditions which determine whether an animal is to be hermaphrodite or bisexual must be considered before any reasonable hope can be entertained of understanding the processes underlying sexual differentiation in a bisexual species. Indeed, some inkling of the need for sex might be obtained from an understanding of the conditions resulting in hermaphroditism, and an explanation of sex on purely physical lines would be captivating from the point of view of the student of nature as a whole. The old idea that an individual is female because its metabolism is mainly anabolic, or male because mainly katabolic, is unsatisfactory, and it has already been pointed out that it is just as likely that an individual is anabolic because of its femaleness, or katabolic because of its maleness.

In reviewing the incidence of hermaphroditism and bisexuality throughout the animal kingdom (again excluding Protozoa) one cannot but be impressed by the independence shown by the organism, which would appear to be able to order its sexual manifestations in a manner entirely independent of phylogenetic considerations, and suggests such a ready response to conditions of life as is perhaps not generally conceived.

The practical points arising out of these speculations may be summarised as follows: Is there a fundamental physical difference between sedentary and active organisms in the whole body or in parts, and if so, is this difference correlated in any way with particular sexual manifestations? To what degree is our present knowledge of the sexual conditions in slow-moving or fixed animals reliable? On the basis of the speculations advanced here any animals which are sedentary, fixed, or slow-moving may be suspected of hermaphroditism in some form.

No wholly satisfactory explanations have been advanced for either hermaphroditism, bisexuality, or indeed sex itself. Sex is universally expressed amongst the higher living organisms at least, so that one is tempted to ask: Is sex merely a property of living matter and hermaphroditism that modification of the property resultant upon the absence of motion in the living organism, and bisexuality that modification dependent upon free motion? For there appear to be sufficient grounds for rejecting the idea that animals are sedentary because they are hermaphrodite.

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The Separation of Mercury into Isotopes.

EARLY in 1920 Harkins and Broeker reported a separation of chlorine into isotopes, which amounted at that time to an increase in density equal to 1550 parts per million. About six months later Brønsted and von Hevesy reported a separation of mercury, which was, however, only about one-thirtieth as great, or 50 parts per million. On account of the slightness of the density change reported for mercury, the evidence that it had been separated did not appear to be conclusive, so it seemed worth while to attempt a confirmation by the same method—that is, a vaporisation at low pressures. As a result of 4 cuts of 2 on the heavy fraction or residue the density has been increased by 69 parts per million, and by the same number of cuts on the light fraction it has been decreased 62 parts, or the total density

change obtained is 133 parts per million, or 0.027 units of atomic weight.

The mercury was purified by electrolysis, by five fractional distillations at low pressure in a current of pure air, and by one fractional distillation in a high vacuum.

The present evidence that an actual separation of isotopes has been obtained with mercury rests largely in the quantitative agreement between the results of Brønsted and von Hevesy and ourselves with respect to the extent of the separation obtained by a definite cut, which will be termed the *efficiency* of the process. If the efficiency of our ideal apparatus, in which solid carbon dioxide and ether were used for cooling, is rated as 100 per cent., then the efficiency attained by the previous investigators is 75 per cent., while our less ideal apparatus gave 93 per cent. when operated slowly and as low as 80 per cent. when operated rapidly.

We have obtained evidence which seems to indicate that a slight separation of the isotopes of mercury has been secured by a very slow distillation at very low pressures, though a more rapid distillation gave no detectable difference in density.

The relative changes produced in the *atomic* weights of different elements by a definite cut may be termed the separation coefficients. These have the values listed below as determined by calculation, the coefficients for chlorine compounds representing the change in the atomic weight of chlorine. The calculated coefficients are:—Neon, 0.00843; magnesium, 0.00868; lithium, 0.00450; nickel, 0.00758; hydrogen chloride, 0.00950; methyl chloride, 0.00690; chlorine, 0.00494; methylene chloride, 0.00413; chloroform, 0.00295; carbon tetrachloride, 0.00229; and hydrogen bromide, 0.00614. Thus the atomic weight changes most rapidly when chlorine is used in the form of hydrogen chloride. The experimentally determined coefficient for mercury is 0.00570, which is not specially large.

The rate of separation of two isotopes is very nearly proportional to the square of the difference of their atomic weight (or molecular weight when a compound is used), to the product of the mol fractions of the two isotopes, to the logarithm of the cut, and inversely proportional to the atomic (or molecular) weight. This statement and the above coefficients apply as well to molecular diffusion at low pressures as to vaporisation at low pressures.

It is of interest to note that many molecular substances must appear in many isotopic forms. Thus if there are two isotopes of chlorine and three of magnesium there are nine isotopic forms of $MgCl_2$ and seven forms of C_2Cl_4 , while if there are six isotopes of mercury there are sixty-three isotopic forms of Hg_2Cl_2 , which occurs in the form of a vapour. Five of the seven isotopic hexachlorobenzenes also occur in several isomeric forms. Isotopes may be able to produce stereoisomerism with respect to infra-red rays.

WILLIAM D. HARKINS.

R. S. MULLIKEN.

University of Chicago, August 31.

Relation of the Hydrogen-ion Concentration of the Soil to Plant Distribution.

THIS subject has recently assumed prominence among ecologists and soil chemists, and Dr. Atkins's interesting letter, with its valuable data, published in *NATURE* for September 15 (p. 80), directs general attention to it and to the need and scope for further work thereon.

It seems very desirable to bear in mind that there are strong indications that the relation between the

hydrogen-ion concentration and the flora of a soil is mediate, and not immediate. Hoagland has shown that barley will withstand a very much greater hydrogen-ion concentration in a water-culture solution than it will tolerate in a soil. Also, it is known that plants which are usually very susceptible to acidity will thrive in certain soils of California and Sweden the pH of which is between 4 and 5, and that those plants growing in those soils show no response to liming. The inference is that the effect of the hydrogen-ion concentration of the soil on plants is indirect, and that there is some ulterior factor the fluctuations of which are commonly, but not invariably, accompanied by fluctuations of hydrogen-ion concentration. In the search for that ulterior factor it has been fairly well demonstrated that in many soils certain polyvalent ions (chiefly aluminium ions) are the primary cause of the effect of acid soils upon plants. It is clear that in mineral soils variations in the aluminium-ion concentration will roughly correspond with variations in the hydrogen-ion concentration.

I am not aware that any explanation has been advanced to account for the fact stated above, that in some soils a high hydrogen-ion concentration is not accompanied by that effect on plants which usually accompanies such hydrogen-ion concentration in soils. The fact alone seems to preclude any possibility of the effect in question being directly and immediately due to the hydrogen-ion, and if it is due to the aluminium-ion it remains to be shown that a high hydrogen-ion concentration in a soil may sometimes exist without a corresponding concentration of aluminium-ion. That may occur in the presence of much organic matter, for it is well known that in the presence of almost any hydroxy-organic compound aluminium (and ferric) ions are "masked." Presumably the aluminium, in such circumstances, becomes part of a complex electro-negative ion—certainly it does not behave chemically like the aluminium-ion.

So far as I can ascertain, the Californian and Swedish soils that have a high hydrogen-ion concentration which is without detriment to plant growth are all peat soils, and it seems likely that the absence of "sourness" in the presence of acidity may be due to the effect of certain organic compounds upon aluminium salts. This possibility is being investigated here and it seems to offer a solution of some other soil-plant problems.

The accumulation of such valuable data as that given by Dr. Atkins is, as that writer says, necessarily slow. Even at the risk of making it slower it seems important to remember that the ultimate interpretation of such data is likely to be possible only in the light of detailed knowledge of the soils concerned. The relation of hydrogen-ion concentration to plant growth is a relatively simple problem: the relation of the hydrogen-ion concentration of the soil to plant growth is a very complex problem.

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September 17.

The "Proletarianisation of Science" in Russia.

LIKE the majority of people in this country, where the news we receive about what is going on in Russia is often misleading, I know little about the working of the "proletarianisation of science" on which Dr. Boris Sokoloff writes in *NATURE* of September 1. But the omission by Dr. Sokoloff of any account of the constructive elements of this "proletarianisation," with one of which I have

recently become acquainted, suggests that he is more concerned with spreading propaganda against "Bolshevism" than with giving an outline of all the features, good and bad, of the attitude of Bolshevism to science.

The particular constructive element to which I refer is the effort of the Soviet Government to bring the fundamental conclusions of scientific thought within the reach of the "proletariat" with the deliberate purpose of shaping the mental outlook of the masses, and especially of the rising generation, in such a way that the standard of values in everyday affairs will be based on a naturalistic interpretation of man's environment and of his relations to it. In pursuance of this end the Soviet Government has already issued a whole series of elementary text-books ("Estestvenno-Nauchnaya Biblioteka"), which aim at explaining the scientific position in terms intelligible to the "proletariat," many of whom have learned to read only since the advent of Bolshevism. They are written by scientific men who have remained in Russia, and who, like most of our own men of science during the war, have temporarily suspended their "free" researches in order to take part in work directed to particular ends considered by the State to be more immediately important under the existing emergency. The series includes such subjects as "How Man Arose," "Human and Animal Evolution," "The Origin of the World," "What Chemistry and Physics Teach Us," "Popular Astronomy," "Brain and Spirit," "Outline of the History of Geological Knowledge" (by Prof. A. P. Pavlov), etc., as well as translations of Geikie's "Physical Geography" and other books.

It would be difficult to imagine the present Government of any of the nations of Western or Central Europe, evincing such a faith in science, as able to bring about the "change of heart" on which alone a new society could be founded, that in the midst of all the horrors of blockade, invasion, and civil war its publishing department would issue broadcast to the "proletariat" a whole library of introductions to scientific thought.

H. LYSTER JAMESON.

Bees and Scarlet-runner Beans.

I HAVE been much interested by Mr. Harford J. Lowe's letters upon this subject in *NATURE* (August 12, 1920, and July 28 and August 11, 1921), and have been led by them to observe the runner beans in my own garden, which lies fourteen miles to the north-west of London. My experience differs somewhat from Mr. Lowe's, and may be worth recording. Although I searched diligently through the whole summer, I did not, until September 1, find a single open flower that had not been pierced through the base of the corolla by the humble-bees in the way described. During the drought there was never more than an occasional pod, although the plants were strong and the flowers very abundant. But after the rain which fell on August 17 pods at once began to form freely, and there has been a plentiful and continuous crop ever since. I then examined the withered petals clinging to the young pods, and found that these also had always been pierced at the base.

It is clear, therefore, that the evil practice of the humble-bees does not necessarily lead to barrenness, and may possibly not do any harm at all. The drought is indicated as the direct or indirect cause of the initial failure of the crop. Now, in mid-September, the humble-bees do not come out so early, and in the morning I have found a very small proportion of uninjured flowers which were being visited by the honey-bees through the legitimate entrance.

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